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ABSTRACT

A research project evaluated the effectiveness of an Electronic Performance Support System (EPSS). The population consisted of 100 telephone operators in the sales and service department of a Dutch bank. The research ascertained that the EPSS was the support available to operators through a large screen monitor at his or her disposal: a tool environment (to process the data) and an information environment (quick access to up-to-date information). A pretest was preceded by eight semistructured interviews from which researchers learned more about the work conditions in the section, working with the tool, and use of the information part in the support system. During observations, observers sat next to working telephone operators. The variables used in this measurement were conversation time and information sources used. A questionnaire asked 24 operators about their motivation, work, and tool and information use. Pretest results suggested that experienced operators used the information component more frequently than novices and that operators were satisfied with the tool, although administrative improvements were suggested. The real improvement would be made in the information component. Posttest results indicated that operators felt a deficiency of standardization in the work. They were very satisfied with the new information component, which was used more frequently than the old. It did not reduce the search for and use of other information sources. (Contains 10 references.) (YLB)

Electronic Performance Support For Telephone Operators

Paper presented at the AERA 1997, Chicago, IL

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The early eighties witnessed the large-scale introduction of computers to most areas of commerce, industry and education. Inevitably this created considerable change in work procedures and attitudes. In the field of performance technology several electronic support systems have been introduced. Nowadays keywords are "just in time training" and "learning by doing". Computer support and electronic job-aids are approximating the master in the master and journeyman relationship which existed in former times. This chapter is a report of a project in the field of Electronic Performance Support Systems (EPSS). Firstly, the focus is on a definition of a composition of an EPSS. Secondly, the theoretical advantages of EPSS use are stated. Finally the findings of a research project are discussed. The project evaluates and improves an existing EPSS for telephone operators.

An EPSS is an integrated computerised environment that supports and occasionally monitors employees while they perform their jobs. In general an EPSS is made up of the following four components (see figure 1): tools (to perform the job), information (needed to do the job correctly), advice (for the difficult parts of the job) and training (to extend the employees' knowledge and skills). The system is a substitute for, or enhances the support of, a master.

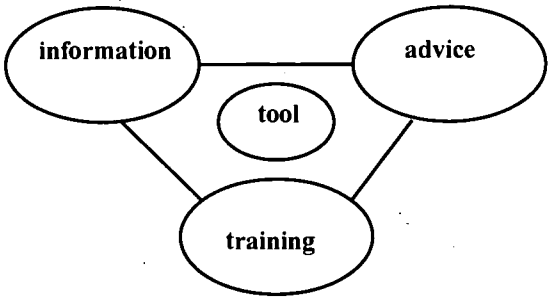


Figure 1: The components of an EPSS

In the literature several possible advantages of the use of an EPSS are reported. These are assumptions of the possible advantages of EPSS use in practice. The first advantage relates to on-the-job training which leads to high transfer, no need to leave the workplace, and more-active learning processes (Bastiaens, 1995). Probably the most important advantage is the immediate access to information, training and advice (Gery 1989, 1991). The just-in-time access to information leads to an extension of the employees' long-term memory and a reduction of the working load memory (Law, 1994). Having continuous access to training means a reduction of formal training in advance of actual task performance. Because employees can constantly consult the advice part of the EPSS it is expected that the need for a supervisor's guidance will be less. This has the additional advantage that the responsibility focus shifts from trainer and training program to the individual's learning needs (Gery, 1991). Moreover, performance support can be important for the employees' self-management, or for the guidance of self-directed teams (Bramer & Senbatta, 1993) and as such has the potential to improve the worker's productivity (Raybould, 1990; 1991).

Problem Statement

In the previous section assumptions on the advantage of EPSS have been mentioned but little has been empirically proven. This research project attempts to evaluate the effectiveness of an EPSS. A few disadvantages were found in the literature that could affect the effectiveness of an EPSS. These disadvantages fall into three categories.

The first category is related to the learning process. "Just-in time" training at the workplace, providing employees with small task-oriented training granules and employees taking control of their own learning process can create problems. Clark (1992) argues that employees may fail to build a unified picture of their job when they have to extract information from an EPSS. Several small information parts will create a fragmented knowledge base. Novices especially need a high level overview of the content to relate details of training. Clark has doubts about the learner control in an EPSS and she illustrates it with the research of Milheim and Martin (1991) which indeed proves that learner control is not as effective as instructional control. This means leaving learners to their own devices and let them make their own decissions is not as effective as let the computer environment taking over control and provide a predefined and structured route.

The second category involves problems related to innovation. It is expected that the introduction and implementation of EPSS will create resistance. Employees are not likely to give up working in "the old way". Even if they are willing to try a new method there is the problem of work pressure.

Employees may believe they do not have the time to use the training support system.

The third category is related to the performance support and the work that has to be done. Is the support adequate? Will "just-in time" support "de-skill" workers? Will it 'demotivate' workers? Or will it automatize the low level tasks and as a result give workers the opportunity to concentrate on high level tasks (Carr, 1992)?

While these issues provide many questions, the research reported in this chapter focuses on the questions stated in the section "research questions".

The Setting

The research project was executed in cooperation with a large Dutch banking organisation which provides banking services and advice by telephone. Their telephone operators are extensively trained for this task. As far as the training and experience are concerned, two types of telephone operators are distinguished. Firstly, there are the experienced operators who have the skills to give advice for all the products the bank has to offer to their clients. Secondly, there are novice operators who start with just a few products. Novice operators combine training and working and extend their knowledge and skills during a period of six months. After six months training the novice workers are considered sufficiently trained to give advice on all the products.

To give advice and information to clients and also to process their clients' data, the telephone operators are supported by a personal computer that

is attached to a mainframe. Each operator has a large screen monitor at his or her disposal. On this monitor it is possible to use a tool environment (to process the data) and an information environment (quick access to up-to-date information) simultaneously. Although a computerbased training part was not included we ascertained these environments together to be an EPSS.

Research questions

The main purpose of the research study is to evaluate the existing support environment and if possible improve it. The research questions are as follows: 1) What is the effect of the existing support environment on the performance and learning of the telephone operators?

2) How can an the existing support environment be improved and raise the effectiveness of the support environment?

3)"What is the effect of the optimisation on the performance of the telephone operators?"

The following hypotheses were developed:

Hypothesis 1 relates to differences between novice and experienced operators: There is a difference between novice and experienced operators. Novice operators need more information and different information than the more experienced operators.

Hypothesis 2 relates to the support of the information component: It is expected that novice operators will appreciate the information component more,

because of a more serious need for information. Lack of information will affect their performance.

Hypothesis 3 relates to the motivation of the operators: Novice operators have a higher motivation but are more insecure about their own performance than experienced operators. For this reason it is expected that novices will have a higher score on the willingness to innovate.

Hypothesis 4 relates to the treatment: It is expected that following the optimisation the new information component will be used more often. It is also expected that a new information component will reduce the use of other information sources. Finally, the assumptions and disadvantages stated in the literature are compared with the effects related to learning, innovation, support and work in this research.

Methodology

To evaluate the support environment the methodology of the one group pre-test post-test design was used (figure 2). This design exists of a pre-test, a treatment and a post-test. For practical reasons it was not possible to use a control group.

The pre-test provides an insight into the information use of both experienced and novice operators. To establish whether there is an improvement after the treatment, a comparison of the results of the pre-test with the results of the post-test are made. For this purpose the post-test was a replica of the pre-test. To improve the reliability of the findings the method of triangulation is used.

This means that the data is collected by various instruments for datacollection and that the results are based on more then one instrument.

The population consisted of 100 employees of the sales and service department savings-accounts. The difference in working experience, age and educational background was measured and the test groups were measured for homogeneity. The outcomes showed no significant difference between the two groups. We concluded there was no difference between the groups.

O1	O2	O3	X	O4	O5	O6

O1 Interviews	O4 Interviews	X Treatment
O2 Observations	O5 Observations	
O3 Questionnaire	O6 Questionnaire	

Figure 2: Overview of the methodology.

The theoretical construct

The conceptual framework included constructs used in an earlier research project (Bastiaens, Nijhof, Streumer & Abma, 1997). The constructs describe the variables that exert an influence on the EPSS (table 1). Working, treatment and background are general variables. The constructs' tool and information together are the support environment. The tool environment is used to process the data and the information environment is used to quickly access information which is needed to perform. Both tools support the operators while they are doing their job.

Next to this, attitude towards work and performance are important in measuring the work context. To understand the knowledge, skills and attitudes learned in the introductory course a number of variables were identified and taken into consideration. The course may influence the use of the tool and the information environment.

Variables were derived from the constructs from which items were developed for the questionnaires given to the operators.

Constructs	Variables
Work	
attitude towards work	motivation, self-confidence
performance	independence
Tool	
communication	interface, technical construct, technical realization
help	content, communication
menu	service and advice
Information	
communication	interface, technical construct, technical realization
information	service and advice, usefulness, structure
information (other origin)	information
Course	
preparation on performance	Knowledge, skills, attitude
Background	
Personal	age, gender
Experience	educational background, working and computer
attitude towards innovation	working with new technology

Table 1: A list of constructs

Results of the pre-test

The pre-test was preceded by eight semi-structured interviews. From the interviews the researchers wanted to learn more about the work conditions in the section, working with the tool and the use of the information part in the support system. While we cannot provide all of the results in this chapter the interviews showed that the operators in general were very satisfied with their job. They

liked both their jobs and the tool. However, they were not as satisfied with the information part in the support system. This resulted in a low average use of the information component which was described by obsolete information and a dull interface with too many levels in a hierarchical structure. It was easier to consult a colleague or to use their own notes (which were used very often as an aid to quick reference).

The second instrument used in the data collection were the observations. To collect these data an observer sat next to the telephone operator when he/she was working. The variables used in this measurement were conversation time and the information sources used. The independent variables were gender and experience. Exactly 150 telephone calls were observed. In 37 conversations the ten operators used an information source. Table 2 shows the categories of employees and the information sources used.

Employee	calls	use information component	use other information sources		total
			paper	verbal	
experienced	60 (100%)	3 (5.0 %)	8 (13.4 %)	1 (1.1 %)	12 (20%)
novice	90 (100%)	0 (0.0 %)	19 (21.1 %)	6 (6.7 %)	25 (27.8%)
total	150	3	27	7	37

Table 2: Observed use of information sources in the pre-test.

For information use, experienced employees consulted information sources in 20% of the telephone calls. For novices it was 27.8 % of all calls. Interestingly, novices do not use the information component at all. The general conclusion derived from table 2 is that the information component in the support system was not used very often. The operators more often used another source. A closer look at those sources showed that they asked their colleagues for information

seven times, used written sources such as folders, brochures and handbooks for 27 times.

Regarding the first hypothesis which is related to differences between novices and experienced operators, the observations showed a difference between novice operators and experienced operators. Although the two groups used other information sources, the difference in conversation time was not significant according to the results of a t-test. The average time for experienced operators was 2.28 minutes (s.d. 1.81), for novices it was 2.52 minutes (s.d. 2.31).

The third instrument to collect the data was the questionnaire. In the questionnaire 24 operators were asked about their motivation, work, tool and information use. First their motivation was looked at.

The hypothesis that there is a difference in motivation between novice (n1=8) and experienced operators (n2=15) was not supported. Although we expected novices to have a higher motivation level related to their work, this was not confirmed (Mann-Whitney test, U=55.0, $\overline{R}1$= 11.38, $\overline{R}2$= 12.33).

The hypothesis that novices are more insecure and that experienced operators are more satisfied about their performance was also not significant (Mann-Whitney test, U= 53.0, $\overline{R}_1$=11.13, , $\overline{R}_2$= 12.47). Both types of operators perceive their performance to be high.

The hypothesis that novices score higher on innovation willingness is also not significant. Both groups scored the same on innovation willingness

(Mann-Whitney test, U= 63.5, $\overline{R}_1$= 12.56, ,$\overline{R}_2$= 12.47). There is no statistical difference in how they experience new technology.

Important for the further improvement of the performance support system they were asked about the technical realisation (errors in software, waiting time, etc) of the tool. When the telephone operators were asked their opinion about the tool it appeared that that the two groups had the same opinion about the technical realisation, the help content (procedural information) and the communication with the help content. Table 3 shows the results.

	Pre-test				Post-test			
	$\overline{R}_1$	$\overline{R}_2$	U	p*	$\overline{R}_1$	$\overline{R}_2$	U	p*
technical realisation	15.19	11.16	42.5	p>.05	13.12	14.82	79.5	p>.05
help content	8.57	12.21	32.0	p>.05	11.12	16.68	53.5	p>.05
communication	10.64	11.18	46.5	p>.05	12.54	15.36	72.0	p>.05

* double tailed

Table 3: Opinion about the tool component. $\overline{R}_1$=mean rank novice $\overline{R}_2$= mean rank experienced.

The following results are related to the information component. The operators were asked about the technical realisation, accuracy of the information and the use of other information sources. Table 4 shows no significant differences between the two groups.

When we looked at the use of the information component we saw that experienced operators use the information component significantly more often (Mann-Whitney test, n_1= 8, n_2= 16, U= 26.5, p<.005).

	Pre-test				Post-test			
	$\overline{R}_1$	$\overline{R}_2$	U	p*	$\overline{R}_1$	$\overline{R}_2$	U	p*
technical realisation	14.13	11.69	51.0	p>.05	12.23	14.77	68.0	p>.05
accuracy of information	10.06	13.72	44.5	p>.05	11.31	15.69	56.0	p>.05
use of other information sources	10.13	13.69	45.0	p>.05	11.31	15.69	56.0	p>.05

* double tailed

Table 4: Opinion about the information component in the pre-test and post-test. $\overline{R}_1$= mean rank novices $\overline{R}_2$= mean rank experienced.

So the hypothesis that novices use the information component more often than experienced operators was rejected.

In general the following can be concluded. For most hypotheses the pre-test shows no difference between experienced and novice users. It is surprising that experienced operators use the information component more frequently than novices. All the employees provided interesting suggestions about how to improve the system. These were taken into consideration when a new support system was constructed.

Recommendations for the construction of a new support system

In general the findings show that the operators are satisfied with the tool, although administrative improvements were suggested. The real improvement has to be made in the information component. The data show that experienced users actually do use the information component more often than novices.

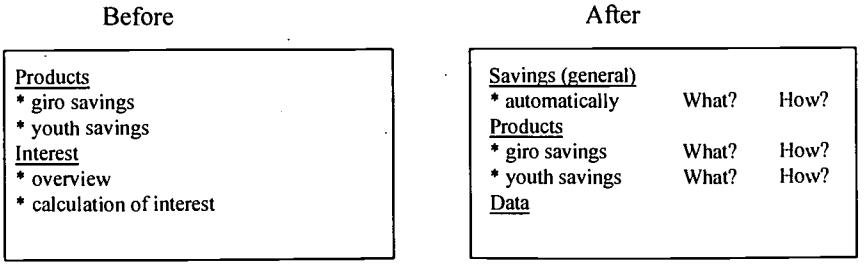
From the interviews we learned that they use it as a reference book simply because not every detail of a product can be remembered. On the other hand

novices use other information sources more often, even for factual knowledge (where experienced users use the system). The novices told us that they do not know how to use the system because they are confused by its hierarchical design. They find it hard enough to advise a client and operate the telephone system without using an information system that is not user friendly.

It is also interesting that they need another kind of information. The information they require is not solely knowledge of the facts but also instructions about how to do the job. This sort of procedural information was not yet available in the system. The evaluation showed that it is important that users can trust the information and that therefore information has to be relevant, accurate and up-to-date. The final important recommendation is that the search and use of the information component has to be an integral part of the overall performance. That means the operators have to integrate the information search as a skill in their performance.

The recommendations require a context and a task analysis before a new information component can be constructed. Also some technical conditions have to be taken into account.

In figure 3 the schematic design of the traditional information component and the constructed new information system with a maximum of three layers and help questions (Bastiaens, 1994) are shown.



Various * address and phone

Figure 3: Outline of the system before and after its redesign.

Results on the post-test

The post-test consisted of the same instruments and identical variables as used for the pre-test, so semi-structured interviews (n=8) were used first. As in the pre-test the operators in general are very satisfied with their work. One important item they told the researchers the second time was that there was a deficiency of standardisation in the work. Although the EPSS provides some standards to process the data, operators want more uniform procedures. The operators are also less positive about the communication process in the division. New rules, products and procedures are not communicated as quickly as they should be. They are very satisfied with the new information component. They use the information component because of the new user-friendly structure and the up-to-date information. On the other hand, because of a lack of time at the workplace they would like to explore the component off the job. They miss a personal scratch-pad in the system and the possibility to structure the interface themselves.

The next part of the post-test were the observations. Again 150 calls were observed. In table 5 the results are shown.

Employee	calls	use information component	use other	information sources	total
			paper	verbal	
experienced	60 (100%)	4 (6.7 %)	2 (3.3 %)	3 (5.0 %)	9 (15.0%)
novice	90 (100%)	7 (7.8 %)	14 (15.6 %)	9 (10.0 %)	30 (33.3%)
total	150	11	16	12	39

Table 5: Observed use of information sources in the post-test.

The table shows that the information system is used 11 times, other information sources 28 times. The total use of information is 39 times. A closer look at the data indicates that the operators consult colleagues 12 times and use brochures and handbooks 16 times. The observations in the post-test again showed a non-significant difference (t-test) in the average conversation time between novice operators (M_1=2.25, s.d.=2.19) and experienced operators.(M_2= 2.19, s.d.=1.48).

The last part of the post-test was the questionnaire. The questionnaire was completed by 27 operators. From table 3 it appears that no significant differences were found when the operators were again asked their opinion about the tool (technical realisation, the content of the help and the communication with the help component).

The results related to the information component (table 4) show that the operators' opinion about the technical realisation was significantly different from their opinion in the pre-test. The accuracy of the information in the information component is appreciated more by experienced operators. The hypothesis related to the support of the information component is not supported by the data. It was expected that novice operators would appreciate the information component more, because of a more serious need for information.
In the use of other information sources no significant differences were found between the two groups.

Comparison between pre-test and post-test

After the development of a new information component the hypothesis is that the new information component is used more frequently than the old one. This happens to be true (χ^2, df= 1, p< .05). Novices especially, use the information component more often. Their score on the pre-test was 0 and after the treatment on the post-test their score was 7. This is significantly different (χ^2, df= 1, p< .05).

It was also expected that the new information component would reduce the search for, and use of, other information sources. This turned out to be untrue and, in fact, the consultation between colleagues has grown. This is not a significant growth (χ^2, df= 1, p>.05). On the other hand the use of written information sources did drop significantly (χ^2, df= 1, p<.05).

The hypothesis that the new information component supports the operators better than the old component is not affirmed. There is a difference in the mean scores in the advantage of the new component but the difference is not significant (Mann-Whitney test, $\overline{R}_1$= 22.94, $\overline{R}_2$= 21.85, U= 250.5, p>.05). Although the users think that the new support is an improvement, this is not reflected in the comparison between the pre-test and post-test scores.

When an evaluation is made on the theoretical assumptions, the projects show that the support environment leads to training on the job. The reduction of formal learning is high. In this organisation formal classroom training is reduced

from one month to six days. The support environment also leads to a reduction of the working load memory. The assumption of resistance was not observed but it was shown that this is hard for the operators to give up old ways of doing their job. The automation of tasks and the easy consultation of the support environment led to an extension of tasks. The results showed that before it was 'demotivating' when operators had to wait too long before they could broaden their knowledge about other products.

Conclusions

The results show that the use of the information component was initially very low. From that a lesson can be learned: an information component has to be up-to-date, complete and its use has to be an integral part of the performance. Our advice was to hire one employee to update the information on a daily basis. This person should not only put in official information but also collect notes and small job aids. Another suggestion is the integration of the use of the support system in the formal learning process. New employees should be taught to work with the support environment. They should be given the time and opportunity to explore the support environment before setting them to work.

Before designing a support system developers have to keep in mind that the people who use the system are very diverse. Potential users have their own needs. They should be given the opportunity to change the interface in their own way, integrate a notepad and provide different ways to search for information.

Although our example is not a complete EPSS as is stated in the first section, it can be concluded that the developed support system in this situation

meets the needs of the company. Developing a complete EPSS in every situation is not necessary. In this project some advantages of electronic support have been supported by data but serious disadvantanges have also been identified. Further research in this field is required to understand not only the design of effective EPSS but more importantly in to get an insight in the analysis of the organisation, the performance and the workers. However performance support has a brilliant future, it will inform and train employees and help them to perform better in a shorter time.

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